

Oxford Physical Science Fellowships

I WRITE this letter that in future candidates for Oxford Fellowships in Physical Science may be aware that outsiders are ineligible.

In June last the Warden of Merton College informed me that the election to a Physics Fellowship would *not* be limited to graduates of Oxford, and would altogether depend on the result of the examination held at Merton on Oct. 7. Candidates had no other information than was afforded by the notice in your columns.

Although I found that great difficulties were thrown in the way of outsiders in their not being allowed an opportunity of examining the physical apparatus which was to be used in the examination, and with which Oxford men are well acquainted, I read for the examination, not having the slightest doubt about my eligibility after receiving the Warden's letter.

It is now nearly four months since I received the letter, and although the authorities must have been very well aware of the grave error which had been fallen into, I was not informed that a blunder had been committed until the morning of the examination. It is now found by the Warden, on consulting the registrar of the university, that only Oxford graduates can compete for these Fellowships.

Oxford, Oct. 8

JOHN PERRY

Simple Method of Studying Wave Motion

IT is difficult for a student to obtain a clear idea of the movement of the particles of a liquid or gas propagating a wave. To assist him models have been devised, but as a rule they are expensive and complicated. The following plan, based on the principle of the stroboscope, I have found extremely convenient. Take a piece of cardboard about 3 ft. long and 18 in. broad. Put this into the tin drum of a "zoetrope," pressing the card well against the interior of the drum, so that it stands up forming a cardboard cylinder. With a lead pencil mark where the inside fold of card comes, and you have the right size of the cardboard to form the cylinder. Divide now the length of the cardboard into 12 equal strips. On each strip paint dots representing the wave you want to study, taking care that each wave is represented $\frac{1}{2}$ behind its predecessor. Lastly, cut out 12 slits, about 8 in. by $\frac{1}{4}$ in., between each representation of the wave; restore the card to the drum of the zoetrope, and then turning the cylinder and observing through the slits, the wave is seen, as the cylinder revolves, to advance with its characteristic motion, while by stopping out all but one of the particles represented the exact character of its oscillation, whether circular, elliptical, or linear, is clearly seen.

Midland Institute, Birmingham

C. J. WOODWARD

The Glacial Period

JUST one line in reply to Frank E. Nipher. I have read Tyndall's Lectures on Heat, and that some time before I addressed you on the subject of the Glacial Period. Plainly, it is against common sense to suppose that an increased outpour of solar energy would diminish the mean temperature of the air at the earth's surface to such an extent that glaciers at or near sea level should be found in Egypt, or even, I believe, in Central Hindustan, as was the case in the Glacial Period. All I can say is, that if the sun then were a hotter sun than the sun of our own age, he must have blundered at his work.

And how may I crave space for just another line on another subject? Could not our learned societies be induced to publish their mathematical contributions separately? I was compelled to take the whole of the first part of the Royal Society's Transactions of 1867, for the sake of Clerk-Maxwell's paper on Molecules. For this I paid a guinea—willingly, indeed; but had the paper been published alone, I should probably have had it for a much lower figure. Then there are Professor Stokes' and Sir W. Thomson's magnificent papers scattered up and down among the Transactions of the Royal and Cambridge Philosophical Societies; if these were gathered together and published apart, it would be a precious boon to persons like myself who are interested in physical mathematics. And pupils of the Ecole Invariantive would, no doubt, be as much gratified by an easier access to the numerous contributions of Professor

Cayley to the Theory of Determinants. Is it impossible, or even inconvenient, to afford such facilities to students and amateurs? Hampstead, N.W., Oct 3

J. H. RÖHRS

THE OWENS COLLEGE, MANCHESTER

IT is now upwards of twenty-two years since this college was opened—for the foundation of which in Manchester, John Owens, a merchant of that city, left 100,000*l.*—in a house that belonged to Mr. Cobden, in Quay Street, which was purchased and presented to the trustees by Mr. John Faulkner, the first chairman. The number of students during the first session was 64, which went on increasing year by year, until last session the day students numbered 327, and the evening students 513. A few years ago it was felt that the original house had become much too small, and that a new building ought to be erected adequate to the increased needs of the College. Accordingly, in 1866, a circular was prepared, setting forth the disadvantages of the then institution, and propounding an extension scheme which should include the additions to the College of a school of Engineering, a Medical School, and the Natural History Museum, which the Council of the Natural History Society recommended should be deposited in Owens College, "if it should appear that the scheme for enlargement was likely to be successfully carried out within a reasonable period." The trustees therefore appealed for funds which would enable them to lay the foundations of an institution which would virtually be the University of South Lancashire, and of the neighbouring parts of Cheshire and Yorkshire.

In 1867 an Extension Committee was formed for raising a fund, which "it was desirable should not be less than 100,000*l.*, and, if possible, 150,000*l.*," to carry into effect the proposed system of extension. 24,000*l.* was almost immediately subscribed. The engineers of Manchester and neighbourhood subscribed 10,000*l.* to found and endow a chair of Engineering Science, and for the provision of an apparatus and a library. An application to the Government for a grant, though never absolutely refused, was first temporarily shelved on the familiar plea that the subject was "under consideration," and on a change of Government it was ultimately forgotten. The success of the College is therefore a monument of voluntary effort. After the present site had been purchased, the sum of 12,000*l.* was subscribed towards the new Medical School. Principal Greenwood and Prof. Roscoe subsequently visited Germany, and obtained valuable information as to the schools of science in that country; and to the plans which the Professor of Chemistry especially brought home, the new College owes the perfect arrangements in its scientific lecture-rooms, and the handsomely fitted-up laboratories for chemical and physiological science; laboratories, we believe, which are not equalled by any in the kingdom, if, indeed, in Europe.

The foundation-stone of the buildings just completed was laid by the Duke of Devonshire in September 1870, and the same nobleman occupied the chair at the opening of the new building on the 7th instant.

As is well known, the "religious difficulty" has been entirely obviated, in the case of Owens College, by the will of the founder, which requires "that the students, professors, teachers, and other officers and persons connected with the said institution, shall not be required to make any declaration as to, or submit to any test whatsoever of, their religious opinions," and that "nothing shall be introduced into the matter or mode of education or instruction, in reference to any religious or theological subject, which shall be reasonably offensive to the conscience of any student, or of his relations, guardians, or friends under whose immediate care he shall be." It is no doubt partly owing to this that the Manchester

College can boast a body of teachers not surpassed in any respect by any university in the kingdom.

The college is rich in scholarships, fellowships, and prizes founded by Manchester men, and by means of these, and its admirable system of day and evening classes, affords facilities to all classes of obtaining a literary and scientific education, both general and professional, of the highest and most advanced kind. In most respects, indeed, it may be regarded as a model institution for the higher education.

Of the many excellent addresses given on the occasion, we have only space for a few extracts from those of Principal Greenwood and Sir Benjamin Brodie. We shall take another opportunity of referring to the address of Prof. Roscoe at the opening of the Chemical School.

Principal Greenwood said:—"I am addressing the assembled students of the new year; and it is because I feel that you are even more concerned in the inquiry than are my colleagues and myself that I ask you to consider some of the relations which subsist between culture and practical life, not as matters of speculative interest, but as bearing closely on the aims and the temper with which you should take up the studies of this place. This inquiry might take either of two directions, according as we consider the debt due from society to the student, or the debt due from the student to society. It is not possible altogether to separate these inquiries; but it is of the latter that I propose to speak more especially this morning, not only because in addressing students, as in addressing other men, it is more wholesome to speak of their obligations than of their claims, but also because in this place and on this day, there is little need to urge the duties of society to the student.

"... For us the normal principles of education, in their whole range and mutual bearings, are of infinitely greater weight than the special questions which fix attention at the moment; but our thoughts are in danger of being drawn away from these deeper truths, and our springs of action of being in that degree weakened or perverted. An illustration of this position may be seen in the history of the vigorous and successful efforts which, within a few years, have been made in favour of the claims of the natural sciences to a leading place in the curriculum of study. Men of genius and of public spirit have insisted on them with unanswerable arguments; and I shall not be suspected by those who happen to be cognizant of the part which Owens College has taken in this matter with any inclination to call these claims in question. I wish, however, to point out that arguments are urged in their support of very unequal force; and that while the able leaders of the crusade dwell most on the stronger among them, their followers are wont to recur too frequently to the weaker, and by raising them into undue prominence to run the risk of inducing—not the general public only, but what is in reality a more serious thing, of inducing you and us to hold pernicious views as to what education is and what are the appropriate motives for it. Of these arguments the weightiest is, I will venture to affirm, the most seldom heard. I mean the assertion that the natural and experimental sciences have a characteristic discipline for the mind. This position may in this place be taken for granted; and it constitutes of itself an argument at once unanswerable and sufficient. But when we hear the further argument that physical sciences should hold a prominent place in education because their promotion contributes to the material advancement of the country, or because to possess a knowledge of them will give the learner a greater command of money and what money brings, we are then offered motives of a very different order. As collateral motives they have great value, I admit, for exaggeration on one side must not be met by exaggeration on the other, but a value subordinate to that of the former consideration. It is, of course, true that all good education,

through whatever medium, tends to produce good and well-furnished citizens, and therefore promotes the general, including the material, well-being of a country; and all good sound education tends to make men manly and self-reliant, and so trains their faculties as to enable them, among other things, to win with ease their share of material good. It is true too, that in choosing the subjects of study regard should be paid, in due degree, to the destination of the future life. But when the secondary and by nature inferior aim takes the first rank, the fatal consequence follows that the higher good is not even sought in the second place. The greater may include the less, but not the less the greater.

"Another instance of harm to the business of education from the passing controversies of the hour lies in the sudden development of the system of competitive examinations. To discuss the merits of this system in itself is altogether beside my object. I wish to refer only to its oblique influence on teachers and pupils, or rather (for each of these schemes would admit of long discussion) of its influence on the temper of the student. Can anything be more deplorable—if it were not deplorable it would be grotesque—than the change which this system threatens to bring about in the mutual relations of study and examination? By the old theory the business of education was—first, the discipline of the intellect by means of the arts and sciences as instruments; and, secondly, the storing of the mind with methodical knowledge gained in the process. Examinations were but the handmaid of the teaching, designed to test and measure the results of study, and so to correct its methods; and if honours and more substantial rewards were conferred on those who took the foremost places, this was partly to stimulate the flagging, and enable the more promising wits to prolong their season of study, and partly that public or academical offices might be filled by the fittest occupants. . . . Now, however, men are almost tempted to think that the public service exists for the sake of the sharp-witted or the industrious, and not they for it. 'La carrière ouverte aux talens,' once the stirring motto of an indignant people, has become a circumlocutory and more decorous version of the frank maxim of ancient Pistol—

'The world's mine oyster,
Which I with sword will open.'

"... We are now prepared to answer the question which I wish to propose: What were the conditions under which for many centuries the theory of the higher education was this—that to all who sought it a common culture was provided in the first instance, and that from this, as from a trunk, three or four types of special or professional training branched off. And again, to what influences is it due that in the present day many are found to advocate the abandonment of this principle in favour of a method by which, the common groundwork being reduced to the narrowest limits, the special training is made to begin with the first years of college life or even at a still earlier date? One answer to this question (but not the only answer) I have already indicated, viz., that according to the older theory 'a complete and generous education,' in the words of Milton, was 'that which fits a man to perform justly, skilfully, and magnanimously all the offices, both private and public, of peace and war;' whilst the other theory holds that the aims and interests of the individual are to be chiefly kept in view. Now it is no doubt true that, as is sometimes urged, these rival theories may be so handled as in appearance to lead to the same result; but in appearance only. It is true that the highest development of any community not only allows, but requires, that the best possible should be made of each of its members; and it is not less true, if less obvious, that an enlightened selfishness might discover that in the long run it can serve itself best by serving others. But 'enlightened selfishness' has been a great many centuries

in learning, in this region as in others, how 'to save by losing itself.' If then, as of course no one will seriously question, the older theory be sound, it will not be safe to leave the course of study wholly to the caprice of individuals. The experience or instinct of academic bodies has aimed at giving effect to this principle by requiring that students aspiring to academic honours, and to those diplomas which are the passports to the so-called learned professions, should pursue a course of studies uniform, or nearly uniform, up to a certain defined point. In our day, when university training is no longer sought only by those who seek to enter the great professions, and when, too, the narrow list of these liberal professions is from time to time receiving one and another sister, it is a principal academic problem to show that the old principles ought still to be insisted on in their essence, and yet that modifications must be made in detail, in order that they may be applied with safety. It is when we have to meet the reluctance—the natural reluctance—of students of this new order to submit to the yoke of academic traditions that we are brought face to face with the rival claims of society and the individual. I say the rival claims; but, in fact, they are not rivals, but complementary each of the other. I mean not only that each has its rights, which must not be ignored, but that each is necessary to the perfect development of the other; that unless due play is given to the special gifts and aspirations of its members, society cannot reach its highest form; and that, unless individual men remember that they exist for the sake of society at least as much as for themselves, they too will fall short of their proper standard, and will leave some of their noblest faculties wholly unused. . . .

"... The subject matter of the studies selected is, in fact, of less importance than the discipline imparted. This only is essential—that there should be such a selection made as will (1) draw out and strengthen the several powers of the mind, and (2) afford a basis so broad that on it may afterwards be erected the structure of professional study when the career is chosen. These conditions are met if the common groundwork includes (1) letters, to cultivate the taste and judgment, to give a good style in speech or writing, and to place the student on the threshold of the best literature of home or foreign growth; (2) mathematics, to discipline the reasoning faculty, to give the habit of concentrated thought, and to place in the student's hand a weapon indispensable for the thorough mastery of the physical branches; and (3) some branch of physical study, to develop the powers of observation and inductive reasoning, and to impart the method of this study, so that, should the student afterwards take up a profession based on some physical science, as medicine, engineering, or manufacturing art, he may be able with facility and pleasure to provide himself with the technical knowledge proper to his calling. It might be added, too, in defence of the claims of this third prime element of culture, that it is singularly fitted to counteract the faults alleged, not without reason, to be inherent in the other two. But I must not proceed further on this field. I have placed the justification of the adoption of a common groundwork of culture for all students on two direct and, as I believe, sufficient pleas. But, over and above these direct uses, there are at least two others, which I can only indicate;—(1) Grace and vigour are lent to social intercourse when men feel that they can trust to the possession by all of a certain general culture—that a common atmosphere, so to say, is shared by all, and that subtle criticisms, delicate shades of thought, apt illustrations, will not fall flat on the ears of one half of those who listen. Those who are familiar with the social history of the first half of this century will agree with me that this element of social life was far more generally present with cultivated men than it is now. (2) And, again, from the want of this common elementary culture, men are without that sympathy with the pursuits of others which tends so powerfully to soften

the bitterness of controversy, and even to make fruitful discussion possible."

Sir Benjamin Brodie's speech is specially remarkable as giving the impression which a long connection with one of the older Universities has made upon a distinguished man, whose sympathies would naturally be with them. We have only space for the following extract:—

"The foundation of such universities as Oxford and Cambridge is lost in almost prehistoric time; and if I say that this is the foundation of an university, I say so from what appears to me to be a very good reason, for I believe that Owens College boasts all the essential constituents of an university; and I have no doubt that before long it will go forth into the world equipped as an university in every respect. I know that some persons take a very different view of universities from that which I do. Some consider that the university is merely a sort of better grammar-school, which differs from the ordinary grammar-school by having more and older students, and a somewhat wider range of study. I don't believe that any enlargement of the curriculum of a grammar-school will ever elevate it into an university. Some persons consider that an university is a body which grants degrees. I confess that the granting of degrees is an important and responsible function; yet of all the functions of an university it appears to me the very least. To claim that function as the distinguishing characteristic of an university is equivalent to saying that the man who puts a stamp on a sovereign is the maker of the coin. An university should not only be a teaching body, but from every point of view it should represent, further, and promote the interest of knowledge, not only by teaching, but by preserving knowledge through the foundation of libraries, museums, and collections, and by the labours of its professors in furthering and increasing knowledge. I fully believe that that was the idea which was present to those who were concerned in the foundation of Owens College—namely, that it is to be not merely a grammar-school, but a great organ for furthering knowledge. . . .

"We have heard many allusions to-day to the financial condition of Owens College, and I do not doubt that there are many here who, in considering this question, look perhaps, I will not say, with some degree of envy, but with a peculiar interest, upon the statistics relating to the pecuniary affairs of Oxford and Cambridge. These great universities differ from Owens College as *plus* differs from *minus*. These institutions—Oxford and Cambridge—are in that happy position that their Chancellors of the Exchequer have no taxes to raise, and have only to consider the appropriate mode of distributing their budgets. But yet, really, any envy which might be raised from this consideration might be entirely removed by a more close intimacy and acquaintance with the subject, for though undoubtedly money is a good thing, and money well used is better than money itself, yet in many cases these endowments of universities have been so connected and linked with inappropriate objects, that they have really done more harm than good. The question of University Reform has been debated for about 30 years without the end being gained as to how to distribute these revenues properly. These revenues are also inappropriate and sometimes mischievous, doing great evil to the old universities in consequence of their application to objects which, though appropriate 300 or 400 years ago, are now useless, or worse. Unhappily these objects do not coincide with those which deserve attention at the present day, and the consequence is that a great amount of time and a large amount of energy and talent have been wasted in removing evils which have grown up in connection with these endowments. I hope that this kind of work will never be necessary in connection with the University of Owens, and I think you may congratulate yourselves that you have to begin *de novo*, and that you have only to adapt your arrangements to the purposes

you desire to be served. That is a much simpler thing to do than to adapt antique arrangements to purposes which they were not intended to serve. Another point in which there are some difficulties that the old universities have had to contend with comes before us in regard to those unfortunate arrangements which for so long a period connected them with a very unpopular party in the State. It is only recently that, by a prolonged series of efforts on the part of individuals, we gained the abolition of what were commonly termed university tests. I do not think I shall offend anybody by referring to that subject, because these tests may now be regarded with a curious, though somewhat painful, interest, like the thumb screws and other instruments of torture of which we read in history; but in reality they constituted a very atrocious evil. We must all regret that they ever existed, not only on account of the labour and difficulty which they involved to those who took an active part in sweeping them out of the way, but also on account of the far worse amount of evil, in the shape of immorality and dishonesty, which they created. However, you at Owens College are happily free from all these evils. I earnestly hope, and fully believe indeed, that Owens College will ever preserve that union between freedom and science—freedom not only to think, but freedom of research and freedom of speech—which is absolutely necessary for the progress of science. I hope that nobody will ever meddle with your professors, and try to put an extinguisher upon their researches."

ON THE APPENDIX VERMIFORMIS AND THE EVOLUTION HYPOTHESIS

TOWARDS the close of the last meeting of the British Association at Bradford, a paper was read before the Biological Section, which calls for special comment, because of the unfavourable impression which it and much of the subsequent discussion must have left on non-scientific as well as scientific hearers, as well as on account of its scientific inaccuracy.

The paper referred to was by Prof. Struthers, who endeavoured to show that the appendix vermiformis of the human intestine may be considered as a good example of a useless and detrimental addition to the vital economy, and, such being the case, it must be apparent to all that evidence of design is not exhibited in the construction of the living body, and consequently the doctrine of special creation must be supplanted by that of evolution.

The general weakness of this argument must be apparent to many at first sight, but there are some points with reference to it which call for special remark. In the first place it may be shown, if it is assumed as true that the appendix vermiformis of the human cæcum is, as stated, useless and positively injurious, that the fact militates quite as much against the doctrine of the evolutionist, as it does against those of the teleological school. For if it is positively disadvantageous, on the Darwinian hypothesis, for the individuals of a species to possess an appendix vermiformis, it is a necessary deduction, that in a very short period either the species should die out, or be replaced by another in which the detrimental organ is absent. The human race and the anthropoid apes, however, seem quite able to hold their own, without the loss of their supplementary cæcum, consequently either the appendix vermiformis causes insignificant danger, or the evolution hypothesis is incorrect.

It is not difficult to demonstrate that it is the former of these two alternatives which fails, that the danger caused by the existence of the appendix vermiformis is much exaggerated, and that its uselessness is only an expression of ignorance on the part of those who make statements to that effect.

Some people have died from perforation of the appendix

vermiformis, or the peritonitis which it induces; the number of recorded cases are comparatively few, and those which follow disease of the rudiment of the vitelline duct in the small intestine are much rarer, though Prof. Struthers seems to have seen several. This shows no doubt that there are disadvantages attending the possession of a complicated cæcum, or an unobliterated vitelline duct; but it shows too much for the argument on which we are considering its bearing, for there are many other organs, avowedly indispensable to the economy, which have caused death by their simple mechanical presence. A case was lately recorded before the Zoological Society, in which a kangaroo met its death from strangulation of a loop of the small intestine by the coiling round it of the uncomplicated, but long cæcum; are we from this to infer that the cæcum is so dangerous an addition to the organism, that it would be better if it did not exist? Such can hardly be correct. Again, in man, if the testes do not descend into the scrotum, impotency is the result, can we therefore infer that the abdominal rings would be better away, because some die of strangulated inguinal hernia? It would be as logical to wish to dispense with the head, because some have been killed by wounds on the scalp.

Again, it can scarcely be said in the present state of our physiological knowledge, that the appendix vermiformis is useless, and a remnant of a fetal structure. Leaving sexual structures out of the question, as subject to different laws, it is quite contrary to evolutionary doctrine that useless rudiments of embryonic organs should be retained in after life; for the individuals encumbered with the unnecessary remains of a former different régime could scarcely be expected to succeed in the struggle for existence against less trammelled and consequently more advantageously circumstanced members of its own or any other class. If also the appendix vermiformis were a rudiment of a fetal organ, it is not easy to see how it is that it is retained in man and the anthropoid apes, whilst it is not found in the lower monkeys, the Ungulata, and other animals which possess a cæcum (the wombat excepted), and are therefore similarly situated in early life. On the other hand, the voice of the evolution hypothesis clearly states that, with the exception above mentioned, the appendix vermiformis must bring positive advantage to its possessors; for it is only developed in the most elaborated and the highest of those creatures which are the result of its unceasing and most beautiful routine, and there is no reason why its action should cease at this point where it is most called for, and where the struggle is most acute.

There is another aspect in which we think the whole subject should be regarded. Prof. Struthers' remarks all have an anti-teleological tendency; in other words, they are little more than hits at a theory which has had its day, and which, if left alone, will die a quiet and natural death. Why make this death a painful one, and attempt to develop an unpleasant party feeling between those who, from the capacities of their brains and their previous education, have been led to adopt the one or the other? Such discussions, as acknowledged by most who are competent to form a correct opinion, do very little, or nothing, towards the advancement of science, and tend to lower it very much in the estimation of the non-scientific world. The true theory will ultimately predominate, without doubt, but it will do so from its own intrinsic value, and not from attacks on the deepest feelings of its opponents, especially when they are based on a false interpretation of its deductions. To quote the words of one of the greatest of our physiologists, it can only bring ignominy on the body of scientific workers if they are supposed to countenance an argument such as that of Prof. Struthers, which assumes that because one or two individuals have died from the impactation of cherry-stones in the appendix vermiformis, therefore there is no God!